

Earth architecture conservation training programme **Khiva - Uzbekistan**



Practical training report

Sebastien Moriset, CRAterre | April 2022

Training organised with the Mamun Academy, Khiva, from the 28th of March to the 7th of April 2022

Acknowledgements

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For more information please contact:

CRAterre

International centre for earth construction, National Superior School of Architecture of Grenoble
CS 12636 - 38036 GRENOBLE Cedex 2 (France)
Telephone + 33 4 76 69 83 35

Chamsia Sadozai, Project coordinator

ch.sadozai@gmail.com

Sébastien Moriset

sebastien.moriset@grenoble.archi.fr

EBRD - UZBEKISTAN

Azamat Matkarimov

1, Qoratosh street 100027 Tashkent (Uzbekistan)
Cell phone: +99897-220-12-34
mazamat@gmail.com

1 Practical training session



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Practical training session

1.1. Background

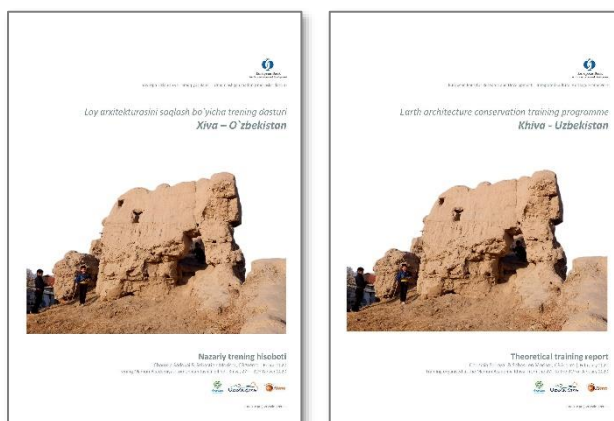
In recognition of tourism and cultural heritage being drivers for significant investment and development opportunities, while in the same time recognizing the importance of managing well the synergy between the cultural sector and the tourism sector, the European Bank for Reconstruction and Development (EBRD) launched in 2018 an Integrated Cultural Heritage Framework to fund projects across sectors, alongside policy dialogues, technical assistance and grants, to support regional development in a holistic manner, leveraging and commercializing cultural heritage resources available in Khiva and Khorezm region while ensuring their preservation and protection.

Uzbekistan has a long-dated history of using earth and mudbricks as building materials for buildings with varied use, from housing to monumental, cultural and religious use. Over time, the climatic changes and natural disasters have affected the condition of the surviving structures and sites, and while local skills in mud restoration have survived over time, they may lag behind on awareness and know-how with regard to modern techniques for preservation and restoration of earthen architecture.

CRAterre has been actively present in the region for many years, and helped in the implementation of UNESCO CenralAsianEarth programme between 2002 and 2012. This programme built capacities to the site-management authorities and technical experts for enhancing conservation, presentation, and management of the world cultural heritage through close cooperation at international, regional, and national levels. Itchan-Kala was part of this programme and several workshops were done in Khorezm and Karakalpakstan.

January 2020 theoretical training session

As part of this earth architecture training programme targeting Khorezm heritage professionals, a first training session was organised from the 27th to the 31st of January 2020. It aimed to strengthen their knowledge on earthen heritage management and conservation through theoretical sessions presenting worldwide practices by other institutions in charge of earthen heritage sites. All the details of this theoretical training can be found in the CRAterre report, available in English and Uzbek language.



January 2020 report by Chamsia Sadozai and Sebastien Moriset available in English and Uzbek

1.2. Practical training preparation

The preparation of this practical course took place at the end of the theoretical training in January 2020. A working session with the course participants was dedicated to the issues they wished to address during the practical course. It is on this basis that the programme was developed. We had also decided together on a date for the course which was from 27 April to 8 May 2020. The global containment linked to the COVID19 pandemic unfortunately did not allow us to hold the training on the initially planned dates. The course was rescheduled several times and was finally implemented from 28th March to 7th April 2022.

The training preparation was done remotely between CRAterre, the Mamun Academy and Dilbar Rakhmanova representing EBRD. Thanks to their mobilization, the participants were notified well in advance of the new course dates and everything was ready in terms of logistics: the site for the practical sessions was chosen, the space for the afternoon's indoor sessions were ready, and coffee and lunch breaks were organized.

1.3. Practical training objectives

The objective of the second session of the course was to improve current conservation practices. This was done by bringing the participants together on one of the towers of the Deshan Kala city external wall, which was not yet restored. The Deshan Kala city wall is currently being rebuilt by different companies under contract with the government which is a good action to preserve these fragile remains in a constantly changing urban environment, but the results are unfortunately very inconsistent. Very good results stand side by side with rushed work which do not last. To meet the objective of improving practices, a small-scale reconstruction sample was proposed to the participants with the target to share ideas on how to obtain the best possible results. This action was carried out on a wall undercut, the wall bases being the most affected by erosion processes in the context of Khiva where rainfall is low.

Apart from the on-site execution of conservation works, the course also aimed to document what is being done. At the end of each afternoon, participants were asked to produce a short daily report of their activity presenting before and after pictures, descriptions of the main stages of implementation as well as the tools and materials used. Examples of conservation reports were presented beforehand to the participants to serve as examples.

In this way, we hope participants will improve on their practices both in terms of implementation and also in terms of documentation of their annual work, the lack of documentation often being a weakness preventing the improvement of practices on the long term.

1.4. Practical training programme

WEEK 1

Monday 28 March 2022	
INDOOR	Welcoming participants Speech by Dilbar Rakhmanova, EBRD and Gavhar Durdiyeva, Mamun academy Presentation of the course objectives and programme by Sebastien Moriset
OUTDOOR	Assessment visit to document the site before works start (photo recording and sketches) Planning and description of proposed interventions (before intervention documentation)
Tuesday 29 March 2022	
OUTDOOR	Site securing (shoring the wall to work on the undercut)
INDOOR	Presentation of intervention proposals by the 2 groups Purchase of materials and tools
Wednesday 30 March 2022	
OUTDOOR	Visit of Itchan Kala wall sections to compare reconstruction shapes Capillary tests
INDOOR	Work on the group reports (drawings of the map showing the various states of conservation levels of the Itchan Kala city wall)
Thursday 31 March 2022	
OUTDOOR	Wall base cleaning and reconstruction of the wall base Documentation of the site
INDOOR	Work on the group reports (drawings)
Friday 01 April 2022	
OUTDOOR	Reconstruction of the wall base Preparation of the 8 stabilised oils for the 8 plaster samples
INDOOR	Work on the group reports



WEEK 2



Monday 04 April 2022	
OUTDOOR	Visit of Itchan Kala wall sections to compare conservation practices Reconstruction of the wall base Preparation of the 8 stabilised oils for the 8 plaster samples
INDOOR	Work on the group reports
Tuesday 05 April 2022	
EXCURSION	Visit of Mechekli Kala and Kalajik Kala
Wednesday 06 April 2022	
OUTDOOR	Reconstruction of the wall base Application of plaster samples Visit of a group of archaeology students with their lecturer (Bahram Sadullaev)
INDOOR	Work on the group reports
Thursday 07 April 2022	
OUTDOOR	Final touches on the wall Cleaning of the site Testing the 8 plaster samples (brushing and watering)
INDOOR	Presentation of the site reports by each group Evaluation of the course Closing remarks and debate Distribution of certificates

1.5. Participants and resource persons in both training sessions

RESOURCE PEOPLE		Theoretical 2020	Practical 2022
	Chamsia SADOZAI	T	
	Resource person, CRAterre, Grenoble, France		
	email : ch.sadozai@gmail.com		
	Sebastien MORISET	T	P
	Resource person, CRAterre, Grenoble, France		
	+336 4652 7465 Sebastien.moriset@grenoble.archi.fr		











EBRD REPRESENTATIVES		Theoretical 2020	Practical 2022
	Azamat MATKARIMOV	T	
	Analyst, Advice for Small Businesses (ASB), SME Finance and Development		
	+99897-220-12-34 matkaria@ebrd.com		
	Dilbar Rakhmanova		P
	Project Manager for the EBRD Cultural Heritage Framework in Khiva / Khorezm		
	+99897-705-52-47 RakhmanD@ebrd.com		

TRANSLATORS		Theoretical 2020	Practical 2022
	Murodbek JUMANIYAZOV	T	P
	Translator, Travel agent		
	+ 99899-666-33-22		
	Olimjon SAIDMAMATOV	T	
	Translator, PhD Student, Urgench University		
	+99899-564-91-70		

PARTICIPANTS		Theoretical 2020	Practical 2022
	Ahmadjon TURDIOXUNOV	T	P
	Retired researcher, former head of an architectural firm		
	+99891-915-59-09		
	Ikromboy RAXIMOV	T	
	Ichon Kala restorator		
	+99891-570-53-58		

	Hamid ABDULLAEV	T	P
	Restorator		
	+99890-719-71-65		
	Ismailjon IBRAGIMOV	T	
	Cultural Heritage Department, Urgench		
	+99899-022-08-02		
	Anvar BOBOJANOV	T	P
	Restorator, Cultural Heritage Department, Urgench		
	+99890-558-88-01		
	Atajanov DILMUROD	T	
	Restorator, Cultural Heritage Department, Urgench		
	+99897-751-48-84		
	Yusufboy KHAJIEV	T	P
	Technical inspector for Architecture Monuments of Khorezm		
	+99891-423-07-96		
	Bahram SADULLAEV	T	
	Senior researcher in Archaeology		
	+99897-458-46-17		
	Avezov SANJAR	T	P
	Specialist Cultural heritage department		
	+998 999-63-60-09		
	Gavhar DURDIEVA	T	P
	Head of Construction Dpt., Materials, Testing and History, Mamun Academy		
	+99897-790-09-90		
	Adilbek ZARGAROV	T	P
	Senior researcher, construction engineer Mamun Academy		
	+99897-458-57-07		
	Azamat YAKUBOV	T	
	Junior researcher in Archaeology, Mamun Academy		
	+99894-237-40-43		
	Ganjayev DAVRONBEK	T	
	Restorator, private company		

	Kahramon SOBUROV	T	P
	PhD student in restoration, Mamun Academy		
	+99893-729-69-40		
	Shihnazar RAHIMOV	T	
	PhD student in Archaeology Mamun Academy		
	+99897-458-28-58		
	Atabek ISMAILOV	T	P
	Itchan Kala press department		
	+998		
	Ergash SALAEV	T	P
	2020 : Researcher in Architecture Monuments, Mamun Academy		
	2022 : Head of Khorezm cultural heritage department		
	Sherzod DUSCHANOV		P
	PHD Mamun Academy		
	+998 90 726 7100		
	Bekzod XUDAYBERGANOV		P
	Mamun Academy		
	+998 91 995 5939		
	Islombek RUSTAMOV		P
	PHD Mamun Academy		
	+998 97 791 2992		
	Zafarbek RAHIMOV		P
	PHD Mamun Academy		
	+998 99 505 5655		
	Shixnazar QURBANOV		P
	Heritage conservator - Architect		
	+998 99 874 9883		
	Dilshod YUSUPOV		P
	Khiva based restorator		
	+998 91 435 4346		
	Oybek BOGILBEKOV		P
	Handicraft and wood carving		
	+998 91 554 9202		

	Sobirjon SOBIROV		P
	Mamun Academy		
	+998 91 277 0688		
	Fazilat DAVLETOVA		P
	Urgentch State University		
	+998 93 750 0854		
	Sadoqat TOHIROVA		P
	Cultural Heritage Press release		
	+998 99 960 6926		
	Dilshod SAYIDOV		P
	Chinobod LLC		
	+998 91 918 0930		
	Baxtiyor MATRIZAEV		P
	Surgut Neft Stroy LLC		
	+998 90 738 3538		
	Daniyar MATRIZAEV		P
	Xiva universal qurilish LLC		
	+998 99 684 44 41		
	Rajabboy RAJABOV		P
	Xarasm Granit LLC		
	+998 90 330 5151		
	Furqat MADRIMOV		P
	Cultural Heritage Department		
	+998 99 502 7379		
	Bakhadir ISHCHONOV		P
	Experienced mud wall conservator and ovens builder		
	+998 99 585 2253		
	18 Archaeology students		Half day only



Practical training session preparation

2.1. Description of the training process

Doing & describing

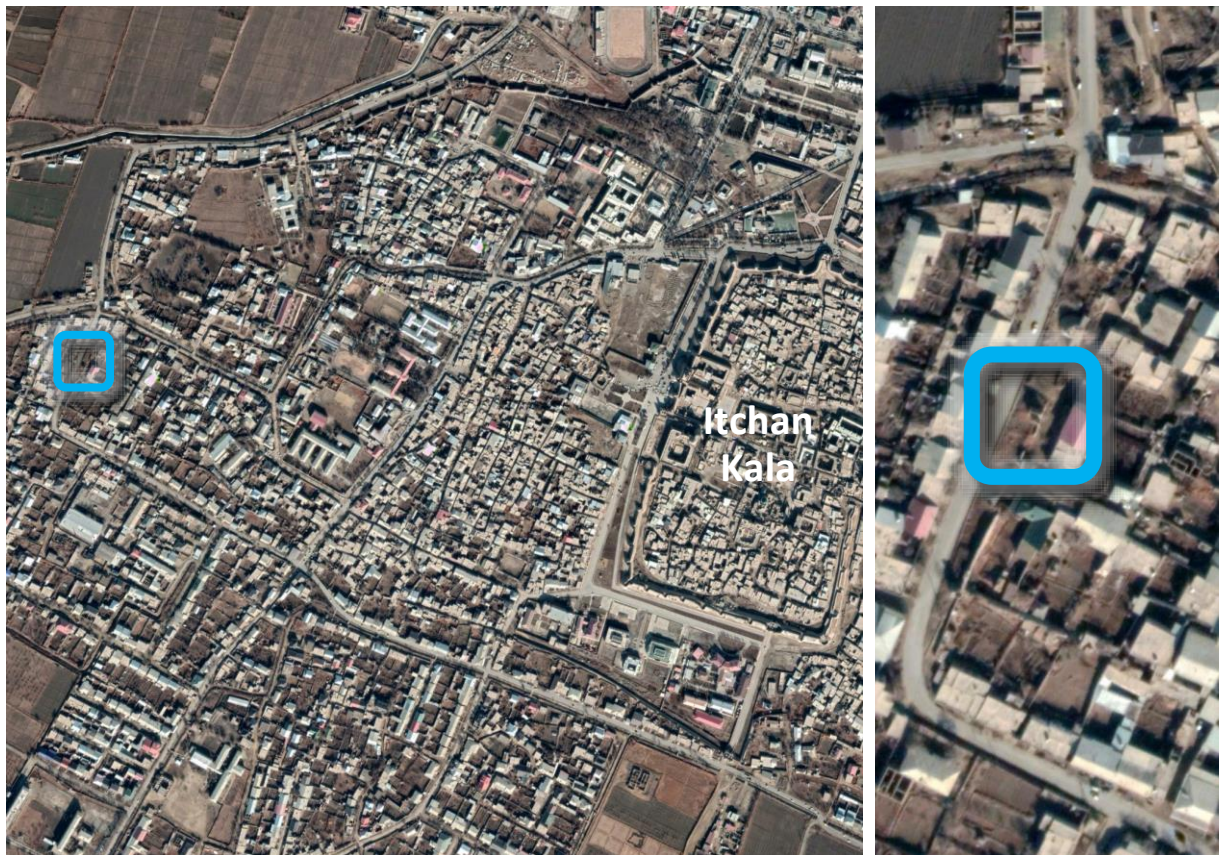
Although the primary vocation of the training was to expose professionals to worksite practices so that they understand the importance of specific gestures and constructive details, we insisted that they also describe the work carried out. The work days were therefore divided into two parts, mornings of outdoor practice and afternoons of indoor reporting and reflection. This daily back-and-forth between reflecting and doing was intended to help them take a step back from certain practices and get into the dynamics of improving them. On the other hand, by documenting everything in the afternoon, they were able to draft a small conservation report that could be used later. These reports are presented in the appendices, on pages 35 to 46.

2.2. Location of the wall tower used as a practice area

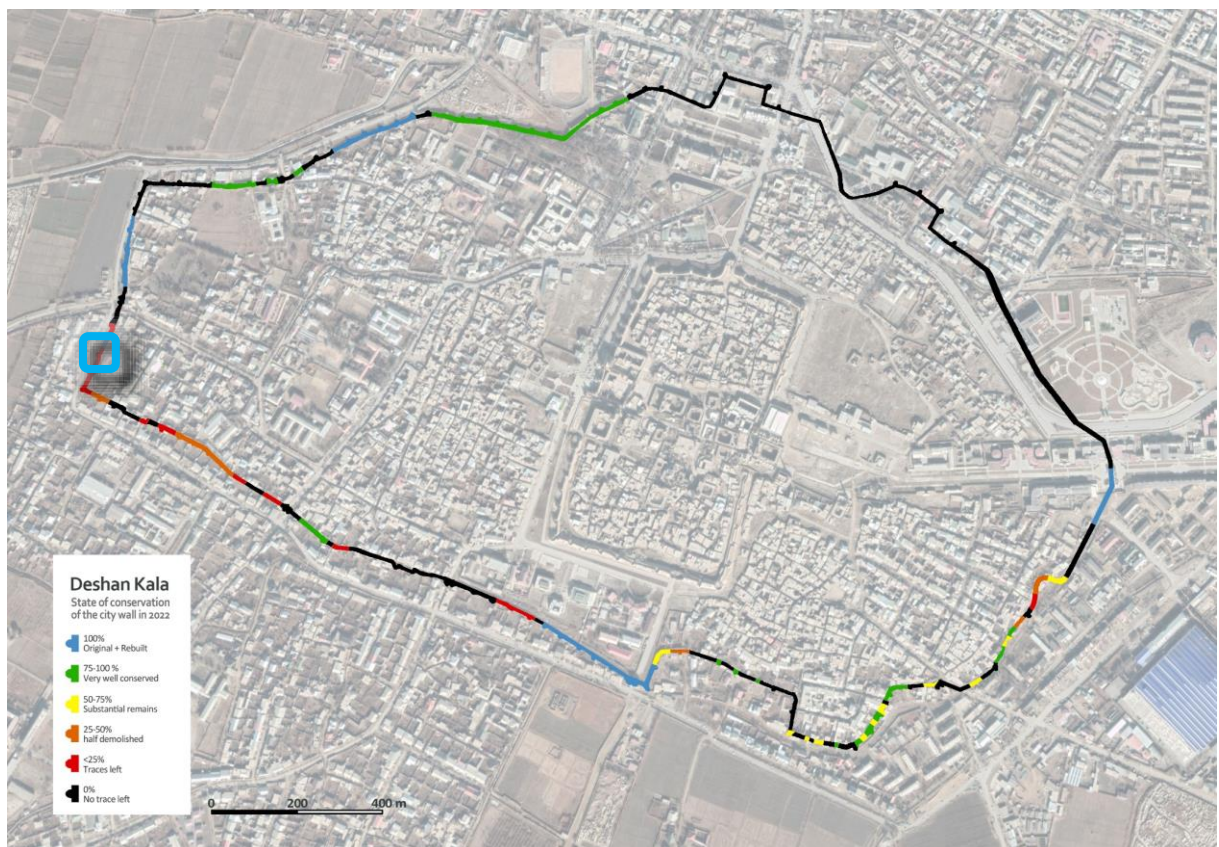
All practical activities were carried out on a badly deteriorated tower of the Deshan Kala wall in its western part.



Ruined tower of Deshan Kala city wall where the on-site training took place



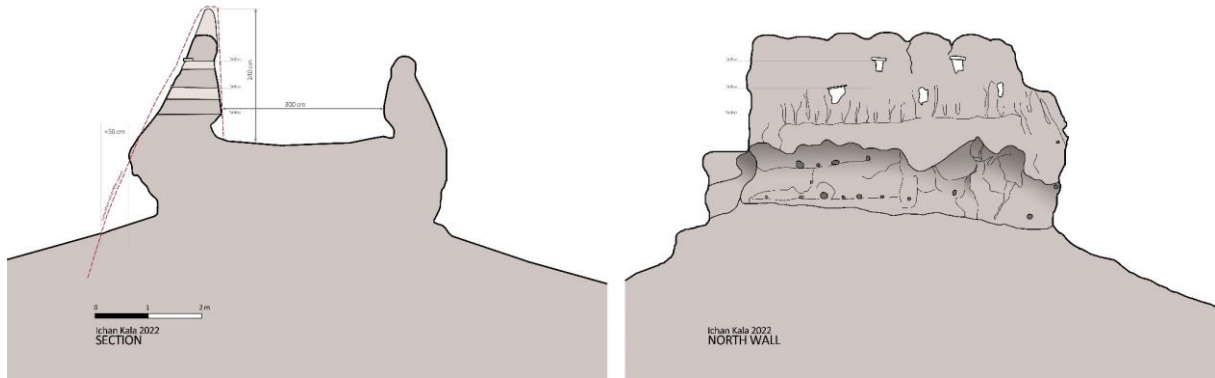
Location of the tower where the on-site training took place in Khiva (Google Earth images)



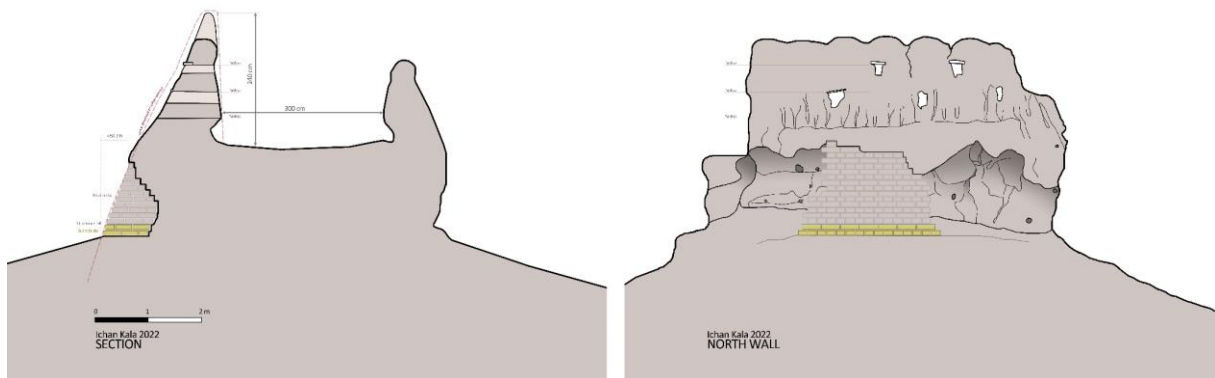
State of conservation of the Deshan Kala wall in April 2022

2.3. Conservation work done

The intervention was carried out slowly and on a small scale, as we wanted to give priority to reflection, debate and experimentation at each implementation stage. Considering that in Khiva the fastest degradation processes of earthen walls occur at the base, we decided, following the diagnosis with the participants, to consolidate the northern part of the tower. This was achieved by reconstructing its severely eroded wall base. Approximately 2 m² of wall were reconstructed during the training.



Drawing of the tower before intervention



Drawing of the tower after intervention



Tower before and after intervention

2.4. Field tests performed

During the course we wanted to show that simple and relatively quick field tests could be performed to compare various materials and avoid large-scale decisions mistakes.

Capillary absorption test

For this test, a brick sample is placed on a wet cloth whose ends are dipped in water. The base of the sample is thus in contact with the wet cloth and the water rises more or less rapidly in the sample depending on its porosity. This test allows to compare absorption speed between various samples.

This test is interesting for checking the porosity of bricks placed at the base of the wall. It is indeed advisable to use non-porous or very low porosity bricks in this area to avoid capillary rise.

The result of the small test showed that the currently used fired bricks absorb water much faster than raw mud bricks. After two hours, the water had risen 12 cm in the fired brick and only 2 cm in the mud brick.

The conclusion of this test is that a capillary barrier between the fired bricks and the unfired bricks is absolutely necessary.



Capillary test after 5 minutes and after 2 hours

Protective plasters testing

Khiva perimeter walls are systematically protected with a layer of earth and straw mortar. It is clear from observation that some plasters work well and last for years, while others deteriorate in the first winter. When discussing with the participants, it became clear that everyone uses his own formula and preparation technique. It is therefore necessary to identify the recipes that work and the appropriate application methods. A first experimental protocol using 8 different additives to the earth was proposed during the training to start comparing different recipes. This is only a first approach. A real research programme is needed in this area as explained in part 3 of the report. Once dry, each of these coatings was brushed with a wire brush to see its resistance to abrasion and then sprinkled with half a litre of water to see the porosity and resistance to erosion.



Wide variety of plaster recipes leading to uneven durability. Other parameters than just the plaster also be considered here



8 samples applied on an old wall during the training

Summary table of plaster tests carried out

Sample N°	Composition		Wet on the wall	Dry on the wall	Remarks
1	soil 3 volumes + straw 2 volumes				This is the most popular, efficient and cheapest recipe. It works well if prepared long time in advance and left to ferment in good moisture conditions to release the cellulose contained in the straw.
2	soil 2 volumes + carpet wool 1 volume				This wool is a waste from the carpet industry. It is difficult to mix and not realistic for large scale use. But it gives good results. Maybe ideal for small repairs such as filling cracks or capping. It would also be ideal for artistic sculptures.
3	soil 2500 g + aloe vera 40 g				The test showed a real waterproofing effect but it should be mixed with straw to avoid cracking. Considering the difficulty to prepare such mixes on a large scale, its use should be kept for capping fragile elements only.
4	soil 36 volumes + sugar 1 volume				Sugar is already used by some contractors in Khiva. The test showed that sugar adds resistance to abrasion and erosion and also reduces cracking.
5	soil 10 volumes + rice 1 volume				For this sample, we mixed soil, rice and water and left the mix for 3 days but the rice grains did not soften up and did not dissolve as expected. Not interesting. A test with rice flower should be made.
6	soil 5 volumes + rice husk 1 volume				Rice husk is a common additive for earth plasters worldwide and is easily available in Khiva. It works well if prepared one week minimum in advance and left to ferment in good moisture conditions to release the cellulose.
7	soil 2 volumes + saw dust (wood) 2 volumes				The test showed that saw dust adds resistance to abrasion and erosion but does not act as a fibre to avoid cracks. It should therefore not be used as the final layer.
8	soil 5 volumes + cow dung 1 volume				Cow dung is also a popular additive worldwide. It works well if prepared long time in advance. Tests should be made with both cow dung and straw.

2.5. Photo selection



Opening remarks by Dilbar Rakhmanova (EBRD) and Gavhar Durdiyeva (Mamun Academy)



Outdoor debates



Indoor work sessions



Classroom presentations



Practical activities on the tower



Practical activities on the tower



Practical activities on the tower



Distribution of certificates



Excursion to Mechkeli Kala



Excursion to Kalajik Kala



Earthen architecture in Khiva

2.6. List of tools and materials purchased

The following tools and materials were purchased. The tools are kept at the Mamun Academy for future training sessions and conservation campaigns.

TOOLS

Woodsaw (small teeth)	1
Hacksaw with spare blades	1
Electric drill	2
Drilling bits set	1
Electric metal grinder + spare discs	1
Mortar mixing pans	8
Buckets	10
Building line 100m	1
Hammer	2
Shovels with handle	8
Trowel standard size	6
Trowel small size	4
Spirit level 60 cm	2
Big paint brush 10-15 cm wide	3
Small paint brush	3
Plastering trowels	2
Brumm	2
Measuring tapes 5 m	4
Wooden mould for sample bricks	1
Metal mould for sample bricks	1
Sieve	1
220 l Water containers	2

MATERIALS

Soil	
Sand	
Lime	
Water	
Straw	
Mud bricks	
Fired bricks	
Nails	
Wooden poles	
Nails	

EQUIPMENT PURCHASED IN FRANCE

Photo cameras	3
Thermographic camera	1
Clinometer	1

DONATIONS BY CRATERRE

Set of books on earthen architecture



Recommendations

3.1. Evaluation and recommendations by the participants

An anonymous evaluation form was distributed in Uzbek to the course participants on the last day of the practical training. They were asked to answer 8 questions with a smiley 😊 😐 😞 😡 and add free comments about their expectations after this course.

Answers to the questionnaire



<small>Sizga Amaliy mashg'ulotlar uchun tanlangan joy yoqdimi?</small> Did you appreciate the location selected for practical sessions	18	3			
<small>Ushbu treynning davomida qilingan ishlardan hursandmisiz?</small> Did you appreciate the work done during the session	20	1			
<small>Boshqa qatnashchilardan ko'p narsa o'rgandingizmi?</small> Did you learn much from other participants	16	3	2		
<small>Sebastiandan ko'p narsa o'rgandingizmi?</small> Did you learn much from Sebastien	21				
<small>Logistikaning yaxshi tashkillashtirilganligi (transport, asbob uskunalari)</small> Did you appreciate the logistics (tools, transport, etc)	21				
<small>Tarjimalarning tushunarlilik darajasi</small> Clarity of the translations	21				
<small>Kofe tanaffusining sifati</small> Quality of the coffee break	18	2	1		
<small>Tushlik sifati</small> Quality of the lunch breaks	20	1			

Anonymous comments: (translated from Uzbek to English by Murodbek Jumaniyazov)

Participant 1

- I am very thankful for the training
- I learnt a lot from this training
- All what we did provided good results
- We should continue training in this field
- This does not help our buildings alone but also helps us built experience
- Thanks a lot to EBRD and Sebastien Moriset

Participant 2

- I liked everything
- All the training went on smoothly
- Sebastien was very hard working
- I want to travel to France
- I learnt a lot from this training
- It is important to have more training like this here because specialists here cannot organise these kind of good experiments
- All was very good
- Thank you very much Sebastien
- I want you to visit us a lot

Participant 3

- It is important to consider salt analysis in our next trainings
- We should collaborate more with archaeologist
- We should keep our old buildings for our old generations

Participant 4

- Sugar is giving good results but people did not believe me before we tested it

Participant 5

- We need more training like this
- We need to keep our heritage for our children
- We want to see our friend from France again

Participant 6

- Training was very good
- By this training we had the chance to teach young generation

Participant 7

- This type of training should be held again in the future because it has both theoretical and practical part
- It is important to mix traditional and modern experience in conservation
- Conservation helps our economy and tourism industry
- I am going to write about this training and promote it in all Uzbekistan

Participant 8

- The seminar was very good
- It is important to have more trainings in order to build good connections between ourselves
- It would be good if our scientists visit and learn from other professionals in France, Iran, Saudi Arabia and other countries.

Participant 9

- Training was very good
- We learnt a lot from this training
- We should practice more on other historical sites as well
- We really want more training like this
- I realised that Sebastien was very good expert
- Training was very well organised
- I wish all the best for Sebastien's future

Participant 10

- It would really be good to visit France and meet with CRAterre people and exchange experience

Participant 11

- The training was very good and we should try this experiment in more sites
- Experimentation on additives should continue such as Aloe Vero that was promising
- We need more tools in our laboratory to check humidity, salt content and strength

Participant 12

- I will use all the training materials in my research
- We will read all the books that Sebastien shared with us
- We are looking forward to attending the next training

Participant 13

- In our next trainings I want to learn more about how to make more durable conservation works at a cheaper cost

Participant 14

- I will use what I learnt in my professional conservation practices and I want to attend the next training sessions

Participant 15

- I want to do more archaeological activities in the next training and I would like to have more specialists from abroad to visit us to cover different topics
- I want in the next training to train other conservators from private companies

Participant 16

- I want this training to last longer
- This would give us more chance to exchange experience with other participants

Participant 17

- I would like to exchange experience with France by studying in France

Participant 18

- I would prefer to have more trainings in order to save our buildings in good condition for the next generations
- We should develop our laboratory as well

Participant 19

- I liked this training very much
- I learnt new things
- It was all well organised
- On my next training I would like to learn about the conservation of paintings and old paper manuscripts
- Is it possible to go to France to learn this?

Participant 20 & 21

- Did not leave comments

3.2. Results and recommendations on the training

This practical training involved 26 participants including inspectors, conservators, contractors, regional officers, and PHD students and 1 resource person from CRAterre. It was a successful activity considering the participants active involvement and positive evaluation.

The participants have been trained on condition survey, experimentation and implementation of conservation and maintenance activities. The practical sessions helped each participant to share his experience, get acquainted with the preventive conservation approach and learn some new techniques. Some of the participants are highly skilled and shared a great wealth of knowledge with the group. For some others, several years of practice are still needed to reach a satisfactory level of expertise in practicing conservation works on earthen structures. The conservation samples implemented during these 2 weeks will permit to monitor and evaluate the efficiency of the techniques implemented as compare to what they are currently doing.

The course led to exciting discussions, both on site and in the classroom in the afternoons. The use of cameras and computers to draft simple daily reports also helped to provide basic training on documentation systems. The two reports drafted by the participants represent a first step in writing down the adapted techniques which can be applied in Khiva for earthen heritage. This dimension remains a great weakness, many people work on conservation in Khiva but they do not leave a written record of what they do, where they do it and with what materials and techniques. It is a great loss for the generations to come and it does not help to improve quality based on previous experiences.

It would be interesting to continue this dynamic of field training because it allows for great exchanges between supervisors who decide and craftspeople who know how to do things. The Khorezm region has talented craftspeople as evidenced by their high-quality contemporary earth architecture, including in rural areas. CRAterre has theoretically nothing to bring to this region in terms of knowledge, because perfection exists. However, the missing bridges must be created so that this ancestral knowledge can be better valued and transmitted to professionals and university students.

We therefore recommend multiplying such courses in the future, for the benefit of the Uzbek community of heritage conservators. The course participants already requested to have other similar gatherings on other sites, on a regular basis. We also recommend that stronger links be developed between the Mamun Academy, professionals and universities, in order to gradually insert the conservation of earthen structures into the curricula of their students. In parallel, teaching materials and documentation in Uzbek language should progressively be developed based on the field experience accumulated over the past years, for the benefit of heritage professionals, students and lecturers teaching conservation. Uzbek heritage professionals seek scientific support (documentation in Uzbek, training) to strengthen their capacities and guide their decisions.

We also recommend, as we did in the January 2020 report, the setting up in Khorezm of a university Diploma course dedicated to earthen architecture like the one we provide in Grenoble. It will take time to set this curriculum in place but CRAterre is willing to bring its experience by training teachers who could design the course and prepare the necessary pedagogical frameworks. The French Embassy is also willing to offer scholarships for Uzbek lecturers willing to embark on this great challenge.

3.3. Research areas to be explored

Archaeology

Archaeologists are currently the main missing actors in conservation work in Khorezm. Interventions are carried out without their involvement, which results in the loss of crucial information and sometimes blocks research that could be carried out in future. Archaeologists try to do conservation in some places (Kat Kala or Kalajik Kala for example) but the results are technically not satisfactory. In short, conservators destroy information that the archaeologists could use and archaeologists do not benefit from the technical knowledge of the conservators. Both parties would benefit from sharing their visions, needs and practices. We therefore recommend the establishment of joint conservator-archaeologist research programmes to ensure that archaeological values are considered on the same level as architectural values in conservation.

Damp proof courses

The best preserved wall sections are those with an effective capillary barrier. The current technique of concrete foundation + brick bed + bitumen or straw capillary barrier works very well technically but it destroys archaeological strata. Research is needed to find more delicate approaches.



Reconstruction with concrete base
and damp-proof course



Reconstruction without
damp-proof course

Building materials

The professionals present at the training course can recognise a good brick at a glance but cannot explain why it is good. Research with brick producers would be interesting to identify the differences in production methods and the possibilities to improve production where products are inferior in quality. The main properties required from the bricks are low porosity and good compressive strength for the lower layers. Erosion resistance is less important because the walls are systematically plastered.



Brickyard



Capillary test



Samples production



Samples production for lab testing (produced during the training session)

Wood reinforcements

The walls seem to be systematically reinforced with cross-beds of timber, of which many traces can be found in the ruins, despite the presence of termites. It would be interesting to study these elements in more detail to find out what species of wood was used, how the wood was treated, whether it was used fresh or dry, etc. This would allow this building feature to be reproduced in reconstruction projects.



Remains of wood reinforcement

Wall preparation

As we reported with Chamsia Sadozai in our 2020 report, the connection between the original parts of the walls and the reconstruction is non-existent. Further work is needed to better connect the original and the new materials so that they work together as one, for load bearing and moisture transmission. Building too fast without trying to connect to the existing wall leaves a gap at the top of the repairs through which water can easily penetrate. Several techniques for preparing the frail surface of the original walls were discussed during the training, such as the application of a lime slurry or a water-sugar solution. Research on these powdered surface sealants would be necessary.



Reconstruction with no connection to the original

Wall shapes

Differences can be observed in the shape of the reconstructed walls. Some have regular straight slopes, others are curved, some even display a double curve (picture below in the middle). It is likely that differences in shape already existed in the original. Further studies by archaeologists and conservators would be desirable to assist conservators in their choice when reconstructing a missing wall section.



Various wall shapes observed on reconstructed walls

Additives for wall plasters

Wall protection is achieved firstly by stopping capillary rise at the base and secondly by protecting the surfaces (sacrificial coatings). These plasters are complicated to apply due to the height of the walls. It is therefore important that they resist as long as possible to reduce maintenance expenses. The observation of various restorations works along Deshan Kala shows a great variability of results in terms of durability. Research is needed to compare recipes and preparation methods. A first testing protocol was set up during the training (see page 15). This is only a demonstration of what could be done. More extensive and long-term research is needed to compare recipes, test various proportions and combine additives, especially fibre-additives and glue-additives. This may result in hundreds of samples to be tested and then ranked in terms of ease of preparation, cost, workability, adherence to old walls, erosion resistance and abrasion resistance. Information on plasters could also be obtained from builders in the region who are not in the conservation business. Earthen construction still accounts for a large majority of contemporary buildings in Khiva (see photos page 23) and these builders certainly have effective recipes to share.



Preparation of stabilised soils and application of plaster samples on an old wall

Documentation

As we have stated several times in this report, the lack of documentation is a barrier to improving practices. Conservation work is carried out by different competing companies in response to calls for tender. These companies carry out their work without submitting a technical report. It is difficult in this context to know what materials they have used, how they have prepared their mortars and plasters, with what ingredients, etc. The contractors present at the training themselves did not always remember what materials they had used when they were asked. It is necessary to think about very simple reporting formats (forms of a few pages) to be imposed on these contractors in order to collect the information for each site and centralise it at the regional office (Ministry of Culture) and the Mamun academy. In parallel, research is needed to analyse this information and produce technical documents that will serve as guides for future generations of conservators. In order to improve documentation, equipment would also be needed. In the framework of this programme, 3 cameras and other small tools have been provided but this is not enough. Computers and a drone would help to document the sites and conservation practices more effectively.



"Aerial" photography



Taking notes on site



Writing reports



Appendixes

4.1. Course certificates

Certificate distributed to people who attend both training sessions:



Certificate distributed to people who attend only one of the training sessions:



4.2. Article published during the course

This article was published on KUN.UZ, one of the most active online news platforms in Uzbekistan.



Kun.uz | Расмий канал

JOIN

Foto: Xorazm Ma'mun akademiyasi

YeTTB Xorazmning qadimiy yodgorliklarini saqlashga ko'maklashadi

April 5, 2022

Xiva shahrida Yevropa tiklanish va taraqqiyot bankining (YeTTB) umumlashgan madaniy meroslar dasturi doirasida «Loy arxitekturasini saqlash» mavzusida seminar-trening [boshlandi](#).



Foto: Xorazm Ma'mun akademiyasi

Xorazm Ma'mun akademiyasi bilan hamkorlikda o'tkazilayotgan ilmiy-amaliy anjumanda olimlar va tarixiy-me'moriy yodgorliklarni saqlash, ta'mirlash hamda targ'ib qilish bilan shug'ullanuvchi mutaxassislar ishtirok etmoqda.

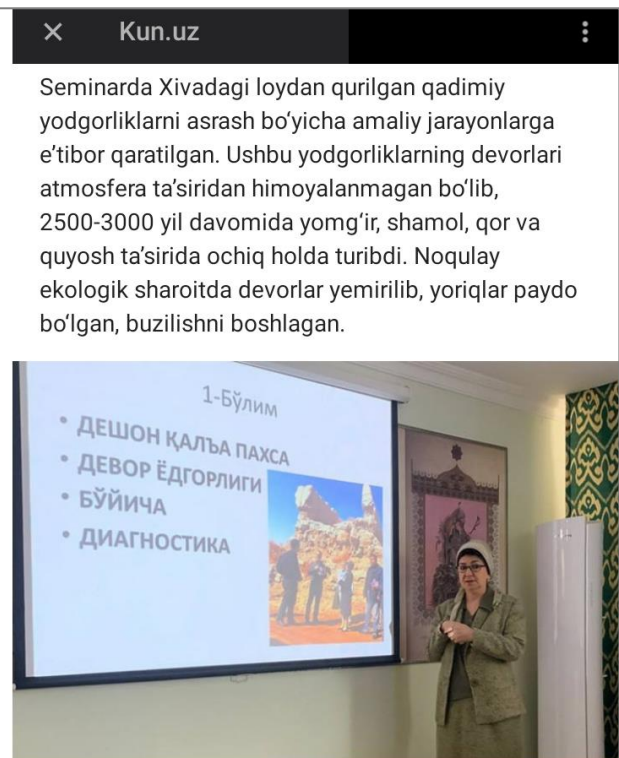


Foto: Xorazm Ma'mun akademiyasi

Xiva shahridagi gil xomashyodan, xom g'isht va paxsadan bunyod etilgan «Deshon qal'a» devorlarining ba'zi qismlarini konservatsiya qilish, qayta tiklash hamda to'g'ri ta'mirlash bo'yicha yangi texnologiyalardan foydalanish imkoniyatlari o'rganilmoqda. YeTTB ushbu jarayonlarga sarmoya kiritishni rejalashtirgan.

«YeTTB Xivadagi madaniy meros obektlarini asrab-avaylash ishlarini rivojlantirish, bu sohaga sarmoya kiritib, turizm sohasining taraqqiyotiga hissa qo'shishni maqsad qilgan», - dedi trening tashkilotchisi, fransiyalik mutaxassis Sebastyan Moriset.

Tarixiy yodgorliklarni saqlash bo'icha yangi ilmiy metodik usullar (gidrofobik (suv yuqtirmaslik) xususiyatini oshiruvchi indikatorlarni ishlatish) samara bersa, Janubiy Orolbo'yidagi dunyo tamaddunida o'z o'rniga ega bo'lgan 100 dan ortiq qal'alarni saqlash masalalariga yechim topiladi.

4.3. Group 1 report

Jamoviy xisobot Mud Walls 2022



1) Diagnostika

- 1.1 Yomon tasir etuvchi faqtorlar
- 1.2 Yomonlashish jarayoni
- 1.3 Zudlik bilan tasir qiluvchi xavf xarakatlar

2) Zudlik bilan qiluvchi kerak bo'lgan ishlar

- 2.1 Joyni xavfsizlantirish (qo'shnilar bolalar)
- 2.2 binoni havfsizlantirish

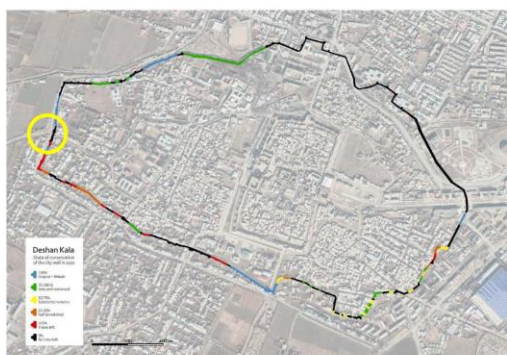
3) Konservatsiya (uzoq muddatli)

- 3.1 Tavsiya qilingan ishlar
- 3.2 Kerakli materiallar

4) Xisobot

Tariflash va bu hafta qilinadigan ishlar sur atlari

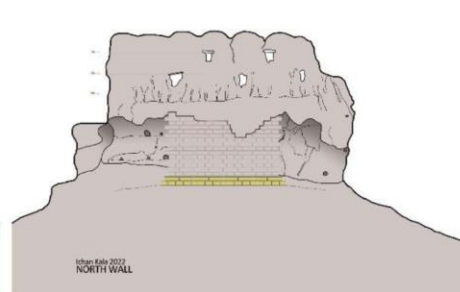
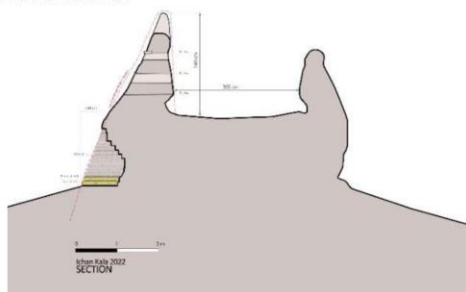




2) Zudlik bilan qiluvchi kerak bo'lgan ishlar

2.1 Joyni xavfsizlantirish (qo'shnilar bolalar)

2.2 binoni havfsizlantirish



28.03.2022

09:00 Mehmonlar bilan tanishuv

14:20 Obyekt joyiga borib nima qilishni o'rgatish ishlarni bajarish

15:30 Obyekt o'lgahov ishlarni olib borildi. Fotolar va videolar tamirlash ishlari boyicha ishlar olib borildi

16:30 Tamirlash ishlari mustaxkamlashib kompyuter dasturida loyihalash ishlari bajarildi



29.03.2022

09:30 Ikki guruh tuzildi xar ikki guruhlar o'zini ishlarini prezintatsiya ko'rinishida tushuntirib loyihaviy takliflarni beriladi. Prezintatsiyada 3d MAX ko'rinishida ishlangan loyiha va animatsiyalar takliflar qilinadi.

15:05 Bozorlik qildik tamir talab qilib turgan hududga kerakli bo'lgan ashyolar, ish qurollari sotib olindi.



30.03.2022

09:30 Paxsa devorga tirgak berish ishlari bajarildi. lekin qiya yog'och berish bilan mustaxkamlash temirbeton himoya



31.03.2022 yil

09:30 G'ish terish ishlarini boshlash

Tekis spada g'ish terish uchun 2 qator pishgan g'ish va geometrik o'lchami qiyoshlash uchun beton armaturasidan shakl yasab ip roslagich yani(xajja tortib) bilan aniqlikni oshirish 2 qatorpishgan g'isht terilib ustidan gidroizolyatsion bilan gozizontal xolda yoyiladi va ustidan bir qator hom g'isht qoyiladi



14:00 Loyihani takomilashtirish uchun kompyuter va foto lavhalardan foydalanish

01.04.2022

09:30 obyekt maydoniga keldik oloy-vera gulini yanchib qo'ydik va uni paksani mustahkamlashda ishlatilindi 1 kg sholi qo'vizi +5kg tuproq qorishmasini aralashtirib bir hafta qo'yamiz.

15.00 obyektidan kelib qilingan ishlar bo'yich hisobot tayyorlandi.



04.04.2022

09.00 Qonstruksiya hisoboti haqida bayonot tayyorlanmoqda. Undan keyin ob'ekt hududiga borib paxsadevorni yonida qolgan g'ishtlarni terdik. Deshan qal'ni restavrasiya qilish maqsadida 8 xildagi loy qorishmasi tayyorlandi. 8 xildagi loy qorishmasi tarkibiga har xil qo'shimchalar qo'shilgan. Kerakli bo'lgan masalliqalar qo'shib aralashtirildi. Tuproqni suyuq qilib turibmiz, chunki u 2 kun turishi kerak. 2 kun turishi uchun suyuqroq qildik. Ba'zi qorishmalarni shakarli suv bilan aralashtirdik.

11:00

№ 1 Shakarli qorishma. 200 gr shaker, 2L sv, elakdan o'tgan 6kg tuproq qorishmasi laganda aralashtiriladi va suyuqroq qilib qo'yiladi, 2 kun davomida.

№2 Aloye qorishmasi. Aloye yaproqlari 0,5 sm uzunlikda qirqilib maydalanadi va undan 100 gr olinadi. Unga 5L suv bilan aralashtirilib 2-3 kg tuproq qorishmasi solinib laganda aralashtiriladi va bu qorishma ham 2 kun davomida eksperiment uchun olib qo'yiladi.

№3 Xorazmcha samonli qorishma. Bu uslub milliy uslub hisoblanadi, chunki u qadim zamonlardan beri paxsa devorlarni suvoq qilishda ishlatilib kelingan. Shunga qaramasdan bu samonli qorishmani boshqa qorishmalar yonida tayyorlandi. 2kg samonga 1kg tuproq qorishmasi va 2L suv qo'shib laganda aralashtirildi va buni ham 2 kunga qo'yildi.

№4. Gilam yungi qorishmasi. 1 kg yunga 3 kg tuproq qorishmasi va 2L suv qoshib laganda qo'yildi.

№5. Yog'och qirindili (apilka)qorishma. 2kg apilkaga 2 kg tuproq qorishmasi va 2 xissa suv qo'shib lagandan aralshtirildi va 2 kunga qo'yildi.

№6. Gungli qorishma. 2 kg gung, 5 kg tuproqli qorishma, 3 xissa suvni idishda aralashtirilib buni ham 2 kunga qo'yildi.

№7 Guruch ushoqli qorishma. 1 kg guruch ushog'i, 10 kg gil tuproq va 5 xissa suv qoshib idishda aralashtirildi va 2 kunga qo'yildi.

№8 Sholi qovuzili qorishma. 1 xissa sholi qovuzi, 5 xissa tuproq qorishmasi, 2 xissa suv qoshib idishda aralashtirildi va 2 kunga qo'yildi.



15:00 Ob'ekt xududidan qaytib shu kungi qilingan ishlarni muhokama qilinib hisobot qilindi.

05.04.2022

07:00 Biz mehmonhona oldidan Xorazm viloyati Tuproqqal'a tumani Meshikli qal'aga tashrif buyurdik. U erda qal'ani hozirgi xolatini organib chiqib uni restavrasiya qilishda tegishli xulosaga kelindi. Undan keyin Bog'ot tumanidagi Qalajiq qal'ga bordik va u erda qal'aning hozirgi xolatini o'rganib uni restavrasiya qilish uchun tegishli xulosalarga kelindi. Elmiy tadqiqotlar davomida o'rganib chiqilgan qal'alarni barqarorligini ta'minlash maqsadida restavrasiya qilish bo'yicha tegishli hulosalar tayyorlamoqdamiz.

06.04.2022

09:30 Biz obyektni xududiga bordik u erda biz qilinib turgan ishlarimizni oxiriga yetkazdik va 8 ta xil qorishmani devorga surtdik ulani sinab ko'rdik qaysi biri yaxshi chiqsa shu qorishmani avval deb topamiz.

15:30 Mexmonxonaga qaytib biz xisobotni oxiriga yetkazdik.

07.04.2022

09:30 Prezantatsiya qilamiz va xisobotni topshiramiz.

4.4. Group 2 report

ЛОЙ АРХИТЕКТУРАСИНИ САҚЛАШ БЎЙИЧА ДАСТУР Хива шаҳар Дешон қалъа деворини сақлаш бўйича амалий ишлар ПЛАН

1. Диагностика.
2. Обидага салбий таъсир қилувчи омиллар.
3. Бузилиш жараёнлари.
4. Зудлик билан таъсир қилувчи хавф хатарлар.
5. Обидани тезкор равишда сақлаш чора ва тадбирлари.
6. Обида худудини хавфсизлантириш (одамлар, болалар таъсирини чеклаш).
7. Обиданинг ўзини техник жиҳатдан хавфсизлантириш.
8. Обидани консервациялаш(узоқ муддатли).
9. Методик кўрсатмалар.
10. Обидада сақлаш бўйича амалга оширилишда зарур асбоб ускуна ва материаллар.



Гуруҳ план асосида Хива шаҳар Дешон қалъа деворининг ғарбий қисмида Қибла тоза боғ маҳалласи, Тош дарвоза кўчасида жойлашган қисмида амалга оширилиши белгилаб олинди.

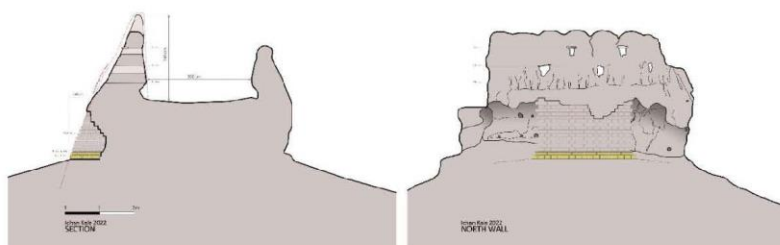


Обидани диагностика қилиш бўйича дастлаб аудиторияда маслаҳатлашиб олинди ва жойига чиқиб бевосита кўздан кечирилди. Кўздан кечиришда деворининг кунгара қисми танлаб олинди. Девор кунгурасининг сақланиш даражаси 30...40% даражада бўлиб, ўта носоз ҳолатда. Носозлик сабаблари қилиб:

Вакт ўтиши билан девор конструкциясининг эскириш натижасида нураши;

табiiй факторлар; ёмғир қор ёғишидан, шамол, қуёш таъсиридан нураш, ер ости сизот сувларининг агрессив таъсирида пойдевор қисмининг шўрланиши,

антропоген факторлар; одамлар томонидан деворга яқин жойларда қурилиш ишларини олиб бориш, унинг деворларини бузиб олиш, обидага жуда яқин жойда автомобиль йўлларини қурилиш, ушбу автомобиль йўллардан жуда оғир юк машиналарини ўтишидан ҳосил бўлган микровибрациялар, шовқинлар.



Обида археологик объект турларига мансуб бўлиб, обиданинг ушбу қисми умумий жиҳатдан илмий ўрганилган. Унинг бузилган қисмида маданий қатламлар диагностика жараёнида аниқланмади. Уни сақлаб қолиш ва архитектура обидаси даражасига қадар тиклаш мақсадида, шунингдек, юқорида келитирилган салбий факторлардан таъсирдан тўла бузилиб кетишини олдини олиш мақсадида тезкор равишда сақлаш тора ва тадбирларини кўриш зарур.

Биринчидан, одамлар ва болаларнинг обида ҳудудида кириши ва яқинлашишини чеклаш зарур.

Иккинчидан, унга яқин жойдан ўтган автомобиль йўлларида автомобиль қатновини каматириш, оғир юк автомобиль ҳаракатини қатъий чеклаш.



Объектни техник жиҳатдан хавфсиз қилиш мақсадида биз бевосита объектнинг ўзида таъмирлаш консервациялаш ишларини олиб боришда амалга оширишни режалаштирдик. Бунинг учун объектда амалга ошириладиган ишларни бажаришда зарур бўладиган қурилиш ашёлари, асбоб ускуналар ва бошқаларни шу атрофдаги қурилиш материаллари дўконларидан сотиб олинди. Жумладан, ғишт объектга яқин жойлашган ғишт заводидан бориб кўриб олинди. Қоришма оддий хом лойдан қилиниши учун зарур соз тупроқ ҳам шу заводдан олинди. Таъмирланиши режалаштирилган қалъа деворининг кунгара қисмининг 1,5 метр қисмида иш олиб бориш режалаштирилди. Ушбу девор қисмида қуйидаги ишлар олиб борилди:

1. Деворнинг асоси бўлган ерларининг ўсимлик ва устки қатлами кўчириб олиниб қаттиқ асосий қатламга борилди.
2. Деворнинг асоси қияликдан иборат бўлгани учун янгидан қилинадиган деворни мустаҳкам ва устивор жойлаштириш мақсадида уни токча кўринишига келтирилиб ишлов берилди.

3. Деворда ишлаш ва кейинчалик техник хавфсиз бўлиши учун унга ёғочдан тиргаклар қўйиш учун ва ер ости сизот сувларининг таъсирида ернинг шўрланиши туфайли юқорига кўтариладиган намликдан сақлаш мақсадида унинг биринчи ва иккинчи ғишт қаторлари пишиқ ғиштдан ишланди.
4. Пишиқ ғиштдан қилинган теримларга цементли қоришмадан фойдаланилди.
5. Эски пахса девор юзига сўндирилган оҳакли сув билан ишлов берилди. Будан мақсад деворда янтоқ ва бошқа турли ўсимликларни ўсиб чиқиши натижасида ва турли хашаротларни ҳаёт фаолиятининг деворга салбий таъсирини бартараф қилади.
6. Пишиқ ғишт териб бўлгандан сўнг ёғоч тиргаклар мустаҳкам қилиб икки жойида ўрнатилди. Ушбу ёғоч тиргаклар янгидан қилинадиган деворнинг ичида қолиб кетишининг ҳисобга олган ҳолда ўрнатилди. Бунинг учун янги деворнинг ташқи контурларини аниқлаш мақсадида деворнинг эски қисми билан унинг сақланиб қолган қисмига унинг асл шаклини такрорлайдиган арматурадан шаблон андазаси ишланиб маҳкамланди.



7. Пишиқ ғишт терими билан хом ғишт терими ўртасига гидроизоляция вазифасини бажарувчи рубероид қатлам қўйилиб, хом ғишт терими бажарилди. Терим ишлари давомида пишиқ ва хом ғиштларнинг сув шимувчанлиги аниқлаб борилди.



8. Гишт терим ишлари бажариш баробарида 8 хил таркибдаги лой қоришмалари намуналари тайёрланди. Жумладан уларнинг таркиблари қуйидагичадир:

- №1 **Шакарли қоришма.** 200 гр шакер, 2Л св, элакдан ўтган 6кг тупроқ қоришмаси лаганда аралаштирилади ва суюқроқ қилиб қўйилади, 2 кун давомида.
- №2 **Алое қоришмаси.** Алое япроқлари 0,5 см узунликда қиркилиб майдаланади ва ундан 100 гр олинади. Унга 5Л сув билан аралаштирилиб 2-3 кг тупроқ қоришмаси солиниб лаганда аралаштирилади ва бу қоришма ҳам 2 кун давомида эксперимент усхун олиб қўйилади.
- №3 **Хоразмча сомонли қоришма.** Бу услуб миллий услуб ҳисобланади, сҳунки у қадим замонлардан бери пахса деворларни сувоқ қилишда ишлатилиб келинган. Шунга қарамасдан бу сомонли қоришмани бошқа қоришмалар ёнида тайёрланди. 2кг сомонга 1кг тупроқ қоришмаси ва 2Л сув қўшиб лаганда аралаштирилди ва буни ҳам 2 кунга қўйилди.
- №4. **Гилам жуни қоришмаси.** 1 кг юнга 3 кг тупроқ қоришмаси ва 2Л сув қошиб лаганда қўйилди.
- №5. **Ёғоч қириндили (опилка)қоришма.** 2кг опилкага 2 кг тупроқ қоришмаси ва 2 хисса сув қўшиб лагандан аралаштирилди ва 2 кунга қўйилди.
- №6. **Гунгли қоришма.** 2 кг гунг, 5 кг тупроқли қоришма, 3 хисса сувни идишда аралаштирилиб буни ҳам 2 кунга қўйилди.
- №7 **Гуруч ушюкдан қоришма.** 1 кг гурусх ушюғи, 10 кг гил тупроқ ва 5 хисса сув қошиб идишда аралаштирилди ва 2 кунга қўйилди.
- №8 **Шоли шелухасидан қоришма.** 1 қисм шоли шелухаси, 5 қисм тупроқ қоришмаси, 2 қисм сув қошиб идишда аралаштирилди ва 2 кунга қўйилди.



Мазкур қоришмалар тўлиқ сувини тортиб тобигв келиш учун икки кунгв қолдирилди. Бу вақт мобайнида ғишт терим ишлар тажриба участкасида тўлиқ охирига етказилди. Лой қоришмаларини қалъа деворига тажриба мақсадида суваш учун ўлчами 30x30 участкалари белгилаб олинди.

Тажрибалар оралиғидаги бўш вақтдан унумлм фойдаланиш мақсадида ва худуддаги бошқа шундай лой архитектурасига тааллуқли оибдалар билан танишиш мақсадида вилоятдаги обидаларга қисқа сайёҳат уюштирилди. Жумладан, Мешекли қалъаси ва Қалажиқ қалъаси яқин бориб ўрганилди. Ўрганишлар давомида мазкур археологик объектларда ҳам тажрибада бажарилаётган ишларни мазкур обидаларда татбиқ этиш бўйича хулосалар қилинди.

Семинар тренинг навбатдаги иш кунини олдинги кун тайёрланган лой қоришмаларини тобига келганлиги боис бевосита қалъа деворларига олдиндан белгилаб олинган участкаларга суваб чиқилди ва уларнинг ҳар қайсининг таркиби бўйича сувалган участкаларга белгилар қўйиб чиқилди. Шу билан бирга лой намуналаридан ўлчам 10x10x5 бўлган қолиплар тахтадан ишланиб, ушбу қолипларга қўйиб қуритишга қўйилди.



Қалъа деворига сувалган лой намуналар тўлиқ қуригандан сўнг уларнинг мустаҳкамлиги ва едирилишга чидамлилигини текшириш мақсадида сувалга участкаларни ҳар бирининг устки сирти темир четка билан кириб кўрилди. Темир четка ҳар бир сувоқ устидан 10 марта кириб кўрилади. Бундан мақсад сувоқларнинг ташқи таъсирларга чидамлилигини синашдан иборатдир. Ушбу синаш давомида сомон чўплари, гилам жуни ва шакарли таркибли лойлар бошқа таркили лойларга караганда мустаҳкамроқ ва едирилшига чидамли эканлиги аниқланди. Кейин сувоқ намуналарига 0,35...0,4 литр ҳажмдаги сув сепиб кўрилди. Бундан мақсад сувоқларнинг ёмғирлар таъсирига чидамлилигини текширишдан иборатдир. Бунда алоэ суви таркили лой намунаси тезда қуриб яхши натижа кўрсатди.

